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PLASTERER'S MANUAL.

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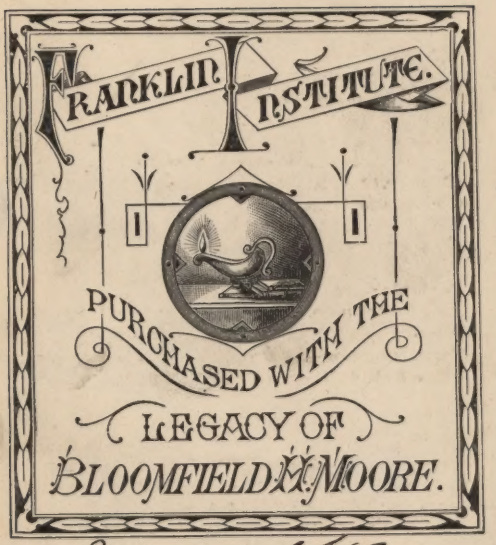
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ARTICLE VII.—Any person removing from the hall, without permission from the proper authorities, any book, newspaper or other property in charge of the Library Committee, shall be reported to the Committee, who may inflict any fine not exceeding twenty-five dollars.

ARTICLE VIII.—No member or holder of second class stock, whose annual contribution for the current year shall be unpaid or who is in arrears for fines, shall be entitled to the privileges of the Library or Reading Room.

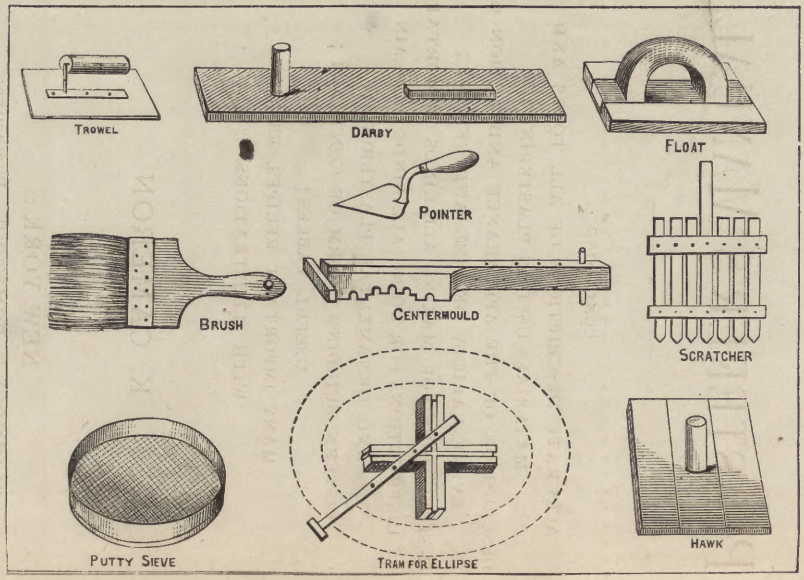
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J. adv act 1883.

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TROWEL
DARBY
FLOAT
POINTER
BRUSH
CENTERMOULD
SCRATCHER
PUTTY SIEVE
TRAM FOR ELLIPSE
HAWK

CAMERON'S

PLASTERER'S MANUAL

FRANKLIN INSTITUTE LIBRARY

CONTAINING

ACCURATE DESCRIPTIONS OF ALL TOOLS AND MATERIALS USED IN PLASTERING;
DESCRIPTION OF THE APPEARANCE AND ACTION OF EVERY VARIETY OF LIME AND CEMENT;
INSTRUCTIONS FOR MAKING ALL KINDS OF MORTAR;
INSTRUCTIONS FOR DOING ALL KINDS OF PLAIN AND ORNAMENTAL PLASTERING;
CISTERN BUILDING; FORM OF CONTRACT;
USEFUL TABLES;
MANY IMPORTANT RECIPES, ETC.,
WITH ILLUSTRATIONS.

BY

K. CAMERON.

NEW YORK:
BICKNELL & COMSTOCK, PUBLISHERS.

1879.

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INTRODUCTORY.

After an extended period of practical experience in the plastering business, during which time we have not seen a book of any description devoted exclusively to plastering, we have concluded that it would be a benefit to plasterers in general to write such a work and place it before the public. While learning the trade, and during the first four or five years of our experience in plastering, almost daily occurrences called for just such a book of reference as this one is. Every beginner will experience the same difficulty, and for that reason cannot well afford to do without this book. The experienced plasterer and the contractor will also find the work an invaluable book of reference, as it contains many things which cannot be retained in the memory, but which are of everyday use ; such, for example, as the table of dimensions and capacities of cisterns ; comparison of measures ; tables of weights of material ; proportions of all kinds of mortars ; form of plasterer's contract ; recipes for blackboards, whitewashes, colored washes, kalsomine, granite finish, and a great number of other items of interest and value too numerous to mention. In order to place this work within the reach of all, we have only put in that which is practical, leaving out all theory and

science, except where it is necessary to establish what might otherwise seem doubtful to the inexperienced. We would say to the beginner that he cannot learn the trade from a book alone, for it requires example and practice, as well as precept, to accomplish that end. Therefore he should engage himself as an apprentice to some master workman, such as are to be found in the cities and large towns, and learn the trade thoroughly and then improve upon it. But he should by all means avoid trying to learn from some one who has not half learned the business himself, for then he would in the end be a poorer workman than the one of whom he was trying to learn. He should study well the principles upon which every part of the business depends, and then, with his practical knowledge, he will be sure to succeed.

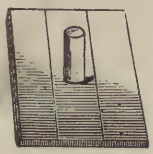
THE AUTHOR.

CHAPTER I.

TOOLS USED.



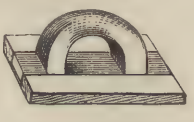
The Plasterer's Trowel—Is the tool which is most used by plasterers, and should be selected with care. It should be made of the best steel, light, springy and about four inches wide by twelve inches long, with a nicely rounded handle. "Diston's improved" is about the style in general favor.



The Hawk—Should be made of hard pine, and from thirteen to fourteen inches square, one-fourth of an inch thick at the edges and three-fourths of an inch thick at the middle, with a cleat nicely dovetailed into the back, to prevent warping. The handle should be from five to five and one half inches in length, and from one and one-fourth to one and one-half inches in diameter.

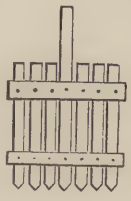


The Darby—Is also made of hard pine, four feet and four inches long by four inches wide, with one handle, similar to the hawk handle, fastened on about one-fourth of the length from one end, and the other handle is a narrow strip fastened with one edge flat on the darby and running lengthwise of it. The length of this strip is generally about eight inches, but some plasterers prefer to have it extend nearly the whole length, for the purpose of stiffening it, but the length may be varied to suit the workman using it, or the nature of the work to be done.



The Float—Is composed of a good wooden handle, similar to a trowel handle (but all wood, and attached at both ends) fastened on the back of a piece of hard pine board, four inches wide by ten or twelve inches long, and about three-fourths of an inch thick. As the face of a float soon wears off and becomes thin, it is best to fasten the handle to a cleat and dovetail the cleat into the back of the face-piece, and keep several of those face-pieces on hand, and when one wears out throw it away and take another, thereby avoiding the inconvenience of

nails in the face of the float, which have to be frequently driven in, to prevent their scratching and marring the wall while floating it down.



The Scratcher—Is made of short slats nailed to cross-pieces and sharpened at one end. The slats should be about one inch apart, and the width of the scratcher about one foot, and the middle slat should be long enough, so that the opposite end from the point can be used for a handle.

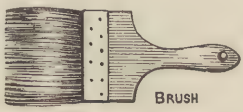
The Straight-edge—Is pine, six feet and upward in length, with a face-piece two and one-half inches wide, nailed upon a back-piece five inches wide in the middle, and tapering to one inch at each end, and is generally made of three-fourths inch lumber.

The Long Rod—Is a plained board, generally six inches wide and one inch thick, with a length nearly equal to the height of the rooms in which it is to be used. These rods are often made with a spirit plumb, inserted like the plumb in a spirit level.

The Angle Block—Is used by many plasterers, and consists simply of a block from ten to fourteen inches in length and three inches in thickness, with its angles right angles, and with a handle on the opposite angle from the one which is to touch the angle of the wall. The handle and the block are generally made in one piece.



The Pointer—Is a small, pointed trowel, the same shape as a brick trowel, with a blade of good springy steel, and only about four inches long. It is used by plasterers principally to clean tools and to work where a larger tool could not be used.



The Plasterer's Brush—Is a kalsomine brush, seven or eight inches wide, made of good bristles, bound with zinc or other metal, and the wood between the two halves of the bristles should be shaved to an edge, so that water will not collect in it and run out as soon as the brush is inverted. The handle is short and permanently fixed in the head of the brush.

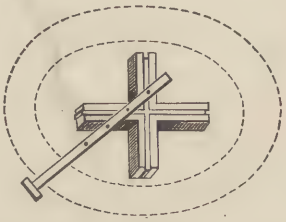
The Paddle—Is a small, flat wooden tool used by some workmen to fill the angles when finishing. It is four or five inches long and from two to two and one-half inches wide, with one end shaved to an edge and the other used as a handle.



Moulds—Are of a variety of kinds. Moulds for full relief ornaments are generally made in sections and put together, leaving an orifice in which to pour the plaster. Moulds for basso relievos are made in one piece. They are made of plaster and glue or beeswax. Moulds for linear mouldings are made of a metal plate cut to fit the moulding, and fastened to a wooden backing, for the purpose of stiffening the mould. Centre moulds of this kind are attached to an arm and swing on a pivot. Cornice moulds of the same description are made with shoes, to slide upon strips and screeds, and the blade or cutting-plate is now set into the bed pieces at an angle of forty-five degrees, so that it will run into the angle and make the mitre.

Mitring Tools—Are used to make mitres by hand where they cannot be easily made with the mould, and also to finish out breaks or balks in the moulding, where the mould is taken off, &c They consist of a number of steel and wooden tools, of a variety of shapes and sizes, among which is the

mitring rod, a flat tool, one-eighth of an inch thick, three inches wide and about one foot long, with one edge sharp and one end beveled to an angle of about thirty degrees, with the acute angle at the sharp edge.



Trammels—Are used to attach moulds to, for the purpose of running mouldings in the forms of ellipses, arches and various other curves, and are made according to the particular use they are required for.

The Mortar Hod—Is made by nailing together the edges of two boards about one foot wide by two and one-half feet long at right angles, forming a trough-shaped box ; an end-piece is then nailed on one end, and the boards are beveled or rounded toward the angle at the other end ; then a handle is attached, a little forward of the middle, and a flat block or pad is placed just behind the handle, to rest on the shoulder of the carrier.

Scaffolds—For plasterers' use are generally made with trussels of height and length to correspond with

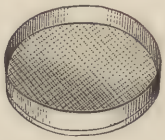
the rooms to be plastered, and covered with planks of a length to correspond with size of rooms. But for very high apartments, such as churches, &c., it is customary to make temporary scaffolds by placing scantlings on end, for standards, and nailing cross-pieces to them, upon which the planks rest. The standards should be well braced, to prevent their falling over.

Mortar Boards—Are generally made about three and one-half feet square, of boards one inch thick, with close joints. The boards are nailed on two solid cleats, and the cleats should be placed far enough apart to admit the head of a barrel between them, as the board is often placed upon a barrel when used. Boards used for finishing are frequently made larger than the ordinary mortar board.

The Slack Box—Should be a solid box made of one-inch boards, and should be at least eight feet long, three feet wide and one foot deep ; but a larger one is often more serviceable. At one end of the box there should be a slide gate with slats nailed on, to prevent the lumps and sediment from passing through when the gate is raised, to run off the lime.

Mortar Beds—Are generally made of boards, and of size and shape to suit circumstances, but not usually more than one or two feet deep. The sides and ends should be strongly fastened together, as they have to sustain a heavy pressure.

The Sand Screen—Is a long, narrow screen, usually about two feet wide by six feet long. It is leaned up at an angle of about forty-five degrees, and the sand thrown against it sifts through as it slides down.



The Putty Sieve. — The "putty" for finish-coat is usually strained through an ordinary flour or meal sieve, which answers every purpose.

CHAPTER II.

MATERIALS USED.

Lime and Hydraulic Cement.—Lime, such as we use for ordinary building purposes, is obtained by calcining or burning calcarious minerals—that is, common limestone or carbonate of l me, which is deprived of the carbonic acid and water contained in it by heat and becomes lime. Limestone which is pure, or nearly so, supports a white heat without inconvenience. The compound limestone, on the other hand, alloyed in the proportions to form hydraulic lime, or eminently hydraulic lime, fuses easily, and its calcination demands certain precautions. The heat ought never to be pushed beyond the common red heat—the intensity being made up for by its longer duration The compound limestone, when too much burnt, is heavy, compact, dark colored, covered with a kind of enamel, especially about the angular parts. It slacks with great difficulty, and yields a lime carbonized and without energy. Sometimes it will not slack at all, but becomes reduced after some days to a harsh powder, altogether inert. Both the pure and compound limestones, when insufficiently burnt, either refuse to slack, or slack only partially, leaving a solid kernel—a kind of subcarbonate, with excess of base.

The characteristics of the various kinds and qualities of lime are as follows :

1st. The *rich limes* are the purest metallic oxides of calcium we possess, and the purer the carbonate of lime from which they are obtained the more distinctly marked are the appearances from which they derive their name. These are that they augment in volume to twice their original bulk, or even more, when slacked in the usual manner ; and that they will not set (harden) under water if not mixed with any other mineral material, even though left immersed for years.

2d. The *poor limes* are those which do not augment in bulk at all, or only to a trifling degree, when slacked. They do not set under water any more than the rich limes.

3d. The *moderately hydraulic limes* set under water in from fifteen to twenty days, but do not become very hard. The change of bulk they undergo in slacking is the same as that of the poor limes, but never equal to that of the richer varieties.

4th. The *hydraulic limes* set in from six to eight days' immersion, and continue to harden for some months.

5th. The *eminently hydraulic limes* set within three or four days, and become quite hard in a month.

Classification of Rocks with Reference to Chemical Examination.

1st. Pure calcarious rocks, or those containing

from one to six per cent of silex, alumina (common clay), magnesia, iron, &c., either separately or in combination, give rich limes upon being calcined.

2d. The limestones containing soluble silica in the state of sand, magnesia, the oxides of iron and of manganese, in various respective quantities, but limited to between fifteen and thirty per cent. of the whole mass, yield poor limes.

3d. The limestones containing silica in combination with alumina, magnesia and traces of the oxides of iron and manganese, in various respective proportions, but within the limits of from eight to ten per cent of the whole mass, yield moderately hydraulic limes.

4th. When the above ingredients are present in the proportions of from fifteen to eighteen per cent., but the silica in its soluble form always predominating, the limestones yield a hydraulic lime.

5th. When the limestones contain more than twenty, and up to thirty per cent. of the above ingredients, but with the soluble silica in the proportion of at least one half of them, the limestones yield eminently hydraulic limes.

The experiments upon which the above conclusions are based appear to show that limes owe their hydraulicity, or power of setting under water, to the presence of a certain quantity of clay, and sometimes, but rarely, to the presence of a certain quantity of pure, soluble silica; and upon that principle a large proportion of our hydraulic cement, or water lime, is

manufactured by mixing common fresh burnt lime with burnt clay and grinding them together, generally, in the proportions of twenty parts of clay to thirty parts of very rich lime, but the proportions vary with the qualities of limestones and clays found in different localities.

Practically speaking, the best quicklime for ordinary plastering, and especially finishing, is white, or nearly so, when slacked—slacks readily, but not too "fiery." Such lime generally makes the hardest wall, works cooler, is not so apt to crack, and bears troweling without peeling when finishing.

Calcined Plaster.—Gypsum plaster, ground fine, calcined and sifted finely is the plaster used for hard finish, stucco work, &c. White, or bluish-white is the best color for general use. It is commonly known as "plaster of paris."

Sand.—Sands are derived originally from the decomposition of the older rocks, either by the action of running waters or by the spontaneous decomposition of the rocks themselves. They are technically distinguished from dust by the fact that they sink at once to the bottom of water without leaving any sensible quantity in suspension. The decomposition of the rocks often gives rise to an agglutinating substance which accompanies the sand and binds it together; but when acted upon by the waters, it soon parts with such heterogeneous particles, and it arrives

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in a comparatively pure state in the beds of the principal rivers. This purity is lost as the rivers approach their embrouchures ; for, in the first place, the diminished velocity of the current allows the heavier particles to subside before arriving there. The water, then, only carries down the light, earthy particles and the decaying vegetable matters which may fall into it, thus giving rise to the formation of clay deposits. The constituent part of sand represents faithfully the rocks from whence they are derived. Thus the granite rocks produce a sand the principal ingredients of which are quartz, feldspar and mica ; the volcanic rocks are represented by sands in which lava, obsidian, &c., appear ; the flat, soft grained sand arises from the disintegration of the schistose rocks ; the calcarious rocks, as might naturally be expected from their soft nature, are those which are least represented in the series, unless in the case of the silicious sands arising from the comminution of the flints so plentiful in some of the secondary formations.

The partial and secondary revolutions of the globe have given rise to immense formations of sand in places where rivers have long since ceased to flow. The sand extracted therefrom is known under the name of "pit sand," to distinguish it from that borne down by the rivers, called "river sand," and from the "virgin sand," which remains in the places where formed, without in any way suffering the action of water. Pit sand is generally of a sharper and

more angular grain than river sand, but in all other respects its composition is identical, excepting that it is occasionally stained by ochres. Practically speaking, clean, sharp, coarse sand is best and makes the hardest plastering, as a general rule, and it is safe to rely on river sand, the coarser the better, within reasonable limits. Lake sand is the same as river sand, and pit sand also makes good work, when the sand is clean and coarse.

Hair.—Cattle hair, from the tanneries, is that which is in general use for plastering mortar. It should be of medium length, and not too lumpy, or clotted with the lime used to separate the hair from the hide.

Marble Dust.—This is sometimes used in hard finishing, and should be about as coarse as sand.

Sawdust.—Sawdust is used in mortar for outside walls, to guard against the action of water and frost. It is the best material known to prevent the plastering scaling off, and should be free from chips and shavings.

Brickdust.—This, when used, is generally used as a coloring material in finishing, and should be sifted through a fine sieve.

Whiting.—Whiting is used by plasterers for whitewashing and kalsomining. The best quality, "French kalsomine," is preferable for such work.

Zinc White—Is also used in kalsomining, when an extra clear white and a fine finish is desired.

Glue—Is also used in kalsomine and washes. White glue is always preferable, especially when there is no coloring used.

Salt—Is used in various washes and in some mortars. Coarse rock salt is generally preferable, and when used in washes is first dissolved in water.

Coloring Material.—As plasterers are often called upon to use coloring in various ways, we give below those which are most commonly used : Lamp black, drop black, ivory black, powdered charcoal, red analine, Venetian red, Indian red, vermilion, ultramarine blue, indigo blue, blue vitriol, Spanish brown, umber (raw and burnt), chrome yellow, clay pulverized.

Brick.—Although bricklaying does not properly belong to the plasterer's trade, nevertheless plasterers occasionally find it necessary to do some of that kind of work when a bricklayer is not at hand ; therefore, we mention brick among plasterers' materials. In selecting brick for outside work, the bricks should be, 1st, Smoothly moulded ; 2d, burned hard ; 3d, well proportioned ; and, 4th, of uniform color. For inside work, cisterns, &c., the principal point is that the bricks be hard—well burnt.

CHAPTER III.

MAKING MORTAR.

Making Mortar—Includes the slacking of the lime, and the mixture of the other ingredients with it. As we have already seen, both the former process and the proportions and nature of the latter differ according to the nature of the lime to be dealt with. It is, however, a universal rule, in contradiction to the slovenly practice of some builders, that lime of whatever nature (excepting hydraulic limes in most cases) should be reduced to a paste before being mixed with the other ingredients. If the sand and other ingredients were mixed with the lime before, thus reducing it to a paste, it would be almost impossible to reduce it to a perfect hydrate, and it would be apt to blister, and slack out, after being applied to the wall. The degree of consistency of this paste should vary with the nature of the extraneous materials, and the purpose for which it is to be used. In order to secure a proper state of the hydrate, it is of great importance that neither too much nor too little water be used in slacking the lime. When too little water is used, the lime "burns," as the plasterers express it—that is, the lime becomes partially dry, and small particles of it fail to slack for want of water, and then when more

water is added, and the mass chilled, those particles do not slack until after the lime is run off, and then they afterwards slack in the mortar bed, or sometimes even after the mortar has been applied to the wall. To say the least, these dry particles will make the mortar lumpy, and cause "blisters" on the wall. On the other hand, if too much water is used, the lime is chilled, or "drowned," as the plasterers say, and thereby loses two-fifths of its strength, according to some of Vicat's experiments; and too much water also retards the process of slacking. Therefore just enough water should be put on at first to start the process of slacking and to keep the lime moist, and as the slacking proceeds more water should be poured on, and the lime kept wet. It should also be stirred during the slacking, after it has begun to warm up, so that when completely slacked it will be in the form of a thin paste. It should then be run off from the slack-box into the mortar-bed, letting it pass through the slats in the end of the slack-box, or through a screen, to strain it and keep back any lumps or flinty sediment that might be in the lime.

For putty coat the paste should be made thinner, like cream or milk, and should be run through a sieve, about as fine as an ordinary flour or meal sieve.

It is also important that no more mortar should be mixed up at one time than is immediately needed, or at most no more than is needed for a few days or

a week or so ; for although the hydrates, which had begun to solidify, give off the water they had rendered latent as it were, yet a portion of their force must evidently be lost by their so doing upon their being re-worked, in proportion to the degree of advancement of the process of setting. And furthermore, although the pure lime gains strength by standing in the state of a thin paste, or putty, without sand or other material being mixed with it, provided it be kept moist all the time, yet, according to careful scientific experiments, it is proven that the increase of strength is hardly perceptible under three or four weeks, and that it increases in strength for five or six months, and that the greatest increase of strength is during the fourth month, and that the gain is then only about one-fifth the original strength of the lime ; and it is plain to any practical man that mortar mixed so long with the sand in it would be considerably set, thereby losing by the reworking and wetting more than it would gain by standing so long ; and if it were hair-mortar for plastering, there would be a still further loss, inasmuch as the hair would be rotted or eaten up by exposure to the action of the moist lime for so long a time ; and the hair cannot well be mixed evenly through the mortar, except while it is in the form of a thin paste, as it is when first run off ; and as Vicat's experiments show, the mortar could not be wet up the second time, and made thin enough to receive the hair properly, after standing so long

without losing *two-fifths* of its strength. Therefore the old notion that plastering mortar should stand for from ten days to three weeks is an erroneous one, and should be discarded, and the mortar should be allowed to lay only long enough for all the particles to become thoroughly slacked.

The proportions of sand to be used vary, as might be expected, according to the nature and quality of the limes, and also of the sand itself ; but within certain limits, if the limes do not gain by the mixture, their effect is not sensibly diminished, to say the least. Thus we find that for the rich limes the resistance is rather increased if the sand be in the proportions varying from fifty to two hundred per cent. of the lime after it is slacked and measured in bulk, in the form of a firm paste, or from one hundred and fifty to four hundred and fifty per cent. of the stone lime itself. Beyond this point the resistance decreases. The resistance of hydraulic limes increases if the sand be mixed in the proportions of from fifty to one hundred and eighty per cent., and from thence it decreases. It is claimed for a few varieties, that they will stand considerable more sand, but the average hydraulic lime will not. As no specific rule for proportions of ingredients of mortar can be given to suit all kinds and qualities of lime and sand, we will simply give the principles by which we must be guided.

For the first coat on lath, it is necessary to have just a large enough proportion of lime to make the

plastering adhere firmly to the laths, and enough hair to make the clinches strong—two pounds to the bushel for instance.

For first coat on stone, brick or grout, and for second coat on lath, the mortar will bear more sand; and hair is not generallly considered essential. When too little sand is used, the plastering is liable to crack in setting and drying, and it is also liable to crumble easily after it is dry; and on the other hand, when too much sand is used, the plastering is liable to fall off, and also to crumble. The correct, but varying medium between the two extremes can only be attained by practice and good judgment.

For the last coat—that is, the putty coat or hard-finish, very little sand is used, and sometimes none; but when sand, stucco, marble dust, etc., is used, it is generally mixed just before using. The stucco is *never* mixed with the putty until it is to be applied to the wall or ceiling, as it would otherwise set and render the whole mass useless.

Care should be taken not to use too much water, either in the mixing of mortar at first, or in the subsequent tempering of it; for, as has been shown, too much water deprives the lime of about two-fifths of its strength, and also retards the crystalization of the setting process.

It will be noticed that mortar does not occupy as much space as its ingredients, taken separately; its greater weight alone proves that fact. Let *a* equal the bulk of the lime in paste, *b* equal the sand, and

c equal the bulk of the water. Then $(a+b+c)$ x 0.75 = the bulk of the mortar they will produce. According to the best experiments, the strength or resistance of good mortar, when set hard, is fourteen pounds avoirdupois per square inch to a force acting in a direction to tear asunder by an effort of longitudinal traction; of forty-two pounds per square inch to a crushing force, and of five and a quarter pounds per square inch to a force tending to make the particles slide upon one another. Old work, which has been hardened by time, and become more perfectly carbonized, will stand a better test.

Hydraulic lime should not be mixed with water until just before it is to be used. Hydraulic or Water-lime is generally called cement, and is usually mixed with the sand dry before the mortar is made wet. The proportions of sand and lime given are for coarse sand; the richer the lime, and the finer the sand, the more sand is required, but fine sand does not make as hard mortar.

CHAPTER IV.

PLASTERING.

Plastering—On laths is done with one, two or three coats, as follows: First, one or two coats of "brown," or coarse mortar is put on, and that is generally finished with a hard-finish or a putty coat. For one coat of coarse mortar hair mortar is used; it is applied to the walls with a trowel and then darbied, and after it has set sufficiently, is darbied and floated down, and generally troweled smoothly. This coat should be laid on heavier than the first coat when two coats of brown mortar are put on. If a putty coat or a hard finish is to be put on over one coat of coarse mortar, the first coat should not be troweled after floating. The brown mortar coat is also left without troweling when it is to be frescoed; though fresco painters differ on that point, and some of them prefer a putty coat or hard finish with plenty of sand in it, and finished with the float to fresco on.

If the first coat is floated when it is too green, the float is liable to leave marks on the wall, and the plastering also is more liable to crack; but on the other hand, if the plastering gets too dry to float easily, water may be sprinkled on the plastering with a brush while floating. This is called water floating.

This process of water floating also tends to harden the plastering. When water is not used in floating hair mortar, hairs will gather along the edges of the float, which should be shaken off every few moments, for if they were left on they would be liable to be rolled under the float, and the pressure would cause them to stick to the wall in tufts and rolls, so that the work could not be smoothly troweled ; and if a finish coat was to be put on, the hair would show through the finish. Sometimes a leveling coat of mortar, either with or without hair, is run on over the first coat, while it is "green," before darbying, and before moving the scaffold. Then the whole is dealt with as in the case of one single coat, and in fact it is called one coat, and in reality is but one, as the first coat, being perfectly green, unites with the leveling coat.

Two coats of coarse mortar are put on as follows, and when finished with a hard finish or a putty coat are called "three coat work :" The first coat is a coat of hair mortar; it is put on the ceiling first, then on the sides as low as the scaffold, and then on the bottoms, as in the case of one coat work, but not quite so heavily ; and it should be well scratched with a scratcher, and not darbied nor floated ; but care should be taken to put it on evenly. This coat is called the "scratch coat," and it should stand until perfectly dry before the second coat is put on, and in no case should the second coat be put on until the scratch coat is perfectly dry, for then the

second coat will adhere to the first as it would to brick or stone; but if the second coat be put on when the scratch coat is only partially dry, the two coats will not stick together, but will soon separate, and the greater part of the second coat will fall off. And as the second coat will never set so well nor be so hard when put on that way, the remainder of it will be very apt to soon crumble off. And furthermore, when the scratch coat is only partially dried and partially set, it is neither tough nor hard, and will not stand the floating, etc., without being injured, and often becomes loosened from the laths, and the clinches become broken, and as a natural consequence of the attraction of gravitation, it *all* falls off, carrying with it, of course, the third coat, if there be any, thus making a "total wreck" of the whole affair. And still men will blindly put on plastering in that way, and wonder why it falls off, generally laying the blame to the materials used. Whereas, three coat work, when properly done, is the very best kind of plastering.

When the scratch coat is dry, then the second coat, which is often called "browning," should be put on as follows: First, if very accurate work is required, spots are put on the walls, with brown mortar, to the required thickness of the plastering. The spots are put on at the base, close to the angles, and also at the top next to the ceiling and close to the angles, and if the rooms are high, spots are put on at about half the height and in lines with the others;

and if the rooms are large, several perpendicular rows of spots are put on at convenient distances. These perpendicular rows of spots should be plumbed with the "long rod" with a spirit plumb inserted in it, and the surface of all the spots on the same wall should lie in the same plane. These spots should also be floated, and if no finish is to be put on they should be troweled. Any time after the spots are set hard, screeds of mortar are put on in horizontal lines with the spots; the screeds should be darbied and floated; then the rest of the wall is filled up even with the screeds and spots, straightened with the straight edge, and darbied and floated, etc., as the screeds were; and if no finish coat is to be put on the whole surface is to be troweled smoothly as the work goes on, leaving no "cat faces" (hollows or uneven places); but if the wall is to be finished or frescoed, it should be left under the float. Only as large a piece of wall should be covered at a time as can be darbied, floated, etc., before it has time to set. In ordinary work the spots may be dispensed with, as the screeds will make the wall accurate enough if they are put on straight. A screed should also be put on around the margin of the ceiling, close to the angles, in order to get them perfectly straight. The first screed should be put on at the base, and the next at the length of the straight edge above it, or at convenient height to correspond with the height of the workman, or the middle row of spots, if such there are. After

browning the lower half of the walls, the scaffold should be put up and the screeds and browning should be put on the ceiling, and then the upper half of the walls. We would recommend water floating this kind of wall, for it makes a harder surface, though it may take a little more time. Cement may be mixed with the brown mortar for second coat if very hard walls are desired, but it should not be mixed until ready for use. Stucco (Plaster of Paris) is sometimes used in scratch coat for ceilings to make the mortar set rapidly and hard. When it is used the mortar should be "gauged" with the plaster after it is placed on the mortar-board, and the scratcher should be used before the plastering sets.

The finish coat should not be put on until the brown mortar is dry and hard, because it would be liable to crack if it were put on sooner.

When the finish is to be simply a putty coat, the putty should have more sand in it than when it is to be a hard finish. Hard finish should be "gauged" (that is, should have the plaster mixed with the putty) after the putty is put on the mortar-board. In gauging the putty, it is customary to make a hollow with the trowel in the pile of putty on the mortar board, and the hollow should be large enough to contain the water and plaster—say from twelve to sixteen inches in diameter for common-sized boards—and the hollow should be made clear to the board, leaving no putty on the bottom,

but leaving it in the form of a ring around the outside of the board. Then the water should be poured in, and the plaster sprinkled in the water, and the whole mass mixed rapidly with trowel and hawk, and applied to the wall or ceiling as quickly as possible, before the plaster has time to set. The finish is generally skimmed on in two very thin coats, one right after the other; but some plasterers prefer to skim three times; and the finish is then only about as thick as an ordinary small sized pane of window glass. It is then immediately troweled several times over with a trowel and wet brush, to prevent "chip cracking," and to give it a smooth surface. If too little water is used in troweling the steel trowel will stain the finish, and if too much water is used it will "drown" or "kill" the plaster, causing it to peel.

After troweling, the whole surface should be brushed with a wet brush once or twice, and if a "buffed" (polished) surface is required, it should be brushed with a comparatively dry brush until a glossy surface is obtained. The brush will, of course, be damp after the first brushing, but should not be dipped in the water during the polishing process. Care should be taken to finish all joinings so that they will not show.

Angles may be finished with the wooden paddle; as the steel trowel is liable to stain the finish, and also to cut into the angles. Ceilings should be finished first, then the upper part of the walls, and then

lower part. Sometimes the walls are finished, top and bottom, at once—one man doing the upper part while another does the lower part; or in very high rooms, several men work together, one above the other, on scaffolds about six feet apart. This is to avoid dry joinings in the finish. Common putty coat is troweled and brushed the same as hard finish.

In plastering on stone, brick, or grout, a scratch coat is seldom put on. Only one coat of coarse mortar is used, and that generally without hair; and the work is rendered about the same as second coat on laths. Where a scratch coat is used, it is like the scratch coat on laths, except that it has a larger proportion of sand and less hair. The finish is the same as on lathed walls.

Plastering on external walls is generally improved by using hydraulic cement in the mortar; and if the wall is exposed to the alternate action of water and frost, sawdust, mixed with the mortar, will prevent the scaling off of the plastering so commonly noticed on such walls. Plaster of Paris will not withstand the action of the weather, and, therefore, is not reliable for external works.

Plastering with hydraulic cement is generally similar to browning. The work must be done rapidly, and only as much mortar should be mixed at a time as can be used before it begins to set much. Cement floors are made by running a screed around the margin and leveling the whole of the floor by the screed. Gravel, brick, stone, or even hard clay will make a good base to cement on for a floor.

CHAPTER V.

CISTERNS.

We give this short article on cisterns because plasterers are so often called upon to build and repair, as well as to plaster them. Therefore a few hints will not be amiss—to the inexperienced, at least.

Cisterns are made in various ways and various forms.

For a very cheap cistern, a hole is dug in the ground and plastered, without walling up, provided that the soil is hard enough to hold the cement; when made quite small, they sometimes last a long time made in that way.

But when something more substantial and durable is required, the walls are usually made of stone or brick. As stone is heavier than brick, and does not generally "break joints" as well, it is more apt to settle and crack, and being rougher, requires more cement to plaster than the same surface of a brick wall. As a rule, hard burnt brick is considered the best material for cistern building. Common cistern walls are generally laid in quicklime mortar, but hydraulic cement is decidedly better, and is almost invariably used for works of much importance.

Cisterns are plastered with mortar made of one part of cement to from one to three parts of sand, according to quality of said materials, but generally two of sand to one of cement. Two coats are generally applied, and sometimes three, waiting for each coat to set before applying the next. Then the last coat is brushed with a wet brush, which assists in hardening the cement.

Filters—In cisterns are made in a variety of different ways, sometimes fixed at the top, where the water is let in, and sometimes a partition wall is built, dividing the cisterns in two compartments, and the water is let into one side and taken out at the other, holes being left at the bottom for the water to pass through the partition. The gravel, sand and charcoal, which is the substance through which the water is filtered, is filled in to a height above the holes in the partition on the side in which the water is admitted. Another, and a cheaper and perhaps more effectual filter is made as follows : An arched mound of brickwork about a foot high is built on the bottom of the cistern in the lowest part ; the pump pipe is cemented into the top of this hollow mound, and holes are left around the bottom, for the water to pass through, and a circular brick wall is built around the mound to a height a little above the tops of the opening left in the bottom. About two courses of brick in height is sufficient for this circular wall, which is placed at a distance of about four inches

from the mound. Then this space is filled with the filtering material, the first and last layer of which should be clean gravel.

The arch of the filter should be cemented before the filtering material is put in. In filling the filter, the second layer of charcoal should be powdered finely. In repairing cisterns, when the cement has cracked, the cement should be cut away an inch or two wide all along the crack, in order to give a sufficient body of the new cement to hold ; otherwise it would crack again in the same place.

When veins of water force their way through from the outside of newly plastered cisterns, the leak can be stopped and the cement set by pressing a hot brick against the fresh cement. The brick must be quite hot.

As the most common form of a cistern is that of a cylinder, we give below a table of dimensions and capacities of cisterns of that form. When the cistern is a cylinder on end, with an arch at the top, add one-third of the depth of the arch to the depth below the arch for the total depth. If the diameter varies all the way, take the average diameter by the depth for the contents. For a greater depth than is given in the following table, multiply the contents of one foot in depth by the depth of the cistern.

The numbers at the top indicate the feet in diameter, and the numbers in the margin at the left indicate the feet in depth ; the other numbers the barrels contained.

Table of Dimensions and Capacities of Cisterns.

Feet in Depth.	4 feet Diam.	5 feet Diam.	6 feet Diam.	7 feet Diam.	8 feet Diam.	9 feet Diam.	10 feet Diam.
1.....	3.33	4.70	6.74	9.18	11.92	15.20	18.74
2.....	6.66	9.40	13.48	18.36	23.98	30.40	37.48
3.....	9.99	14.10	20.22	27.54	35.97	45.60	56.22
4.....	13.32	18.80	26.97	36.72	47.96	60.80	74.96
5.....	16.65	23.50	38.70	45.90	59.95	76.00	93.70
6.....	19.98	28.20	40.44	55.08	71.94	91.20	112.40
7.....	23.31	32.90	47.18	64.26	83.93	106.40	131.18
8.....	26.64	37.60	53.82	73.44	95.92	121.60	149.92
9.....	29.97	42.30	60.66	82.62	107.91	136.80	168.96
10.....	33.30	47.70	67.40	91.80	119.90	152.00	187.40
11.....	36.63	51.70	74.14	100.98	131.89	167.20	206.14
12.....	39.96	56.40	80.88	110.16	143.88	182.40	224.88

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CHAPTER VI.

ORNAMENTAL PLASTERING.

Mouldings—Are made as follows: For cornice mouldings, two plaster screeds are run with the trowel, and straightened with the straight edge, and troweled smoothly, one on the ceiling and the other on the sides, at the proper distance from the angles, for the shoes of the mould to slide upon them; then thin straight wooden screeds are nailed to the walls for a guide, upon which the lower shoes of the mould slide. These wooden screeds should be carefully adjusted, so that the mould may run in a straight line. Where very heavy members of the moulding occur rows of nails may be driven to help support the cornice, being careful to drive them in far enough to be out of the way. The laths are generally left bare in the angles, so that the moulding will clinch through between the laths. If the angles have previously been plastered, cut the plastering away to the width of the moulding.

Everything being ready, enough putty is gauged, with about equal parts of plaster, to run a strip of moulding of convenient length, and the angle is immediately filled to about the thickness of the required moulding; and then the mould is run over the piece thus prepared as quickly as possible, cut-

ting away all the gauged stuff except the moulding; and this process is repeated several times until the moulding is filled out. The last time the moulding should be wet with a wet brush before running the mould over it, in order to fill all small cavities; then finish with the brush to give a gloss, and then go on to the next piece of the cornice, and proceed as before. If a mitre mould is not used, the mitres must be filled out by hand with the mitring rod and other small tools made for that purpose. But the mitre mould works much easier, and saves a great deal of time. It has been heretofore described in the chapter on "Tools used."

Circular and elliptic centre mouldings are run from a centre, with the mould attached to the arm of a trammel, and only one screed is required for the mould to slide upon. Arch mouldings, etc., are also put on in the same way. For a circular moulding, the arm of the mould turns upon a pin or projecting gaspipe. For an elliptic moulding, a trammel of the following description is generally used: two pieces of wood are halved together, at right angles to each other; grooves are cut the whole length of each piece on the same side, so that the grooves intercept each other at the center. The length of these two cross-pieces should be equal, and a little less than the short diameter of the required ellipse. The arm of the mould is similar to that used for a circle, except that it has several holes bored in it, besides the one at the opposite end from where the

mould is attached. One pin is then put in the end hole, and the other in one of the other holes, close to or farther from the end pin, according as the ellipse is to be broad or narrow. These pins should just fit in the grooves in which they are to slide, one in each groove. The distance of the end pin from the mould will equal half of the long diameter, and the distance of the other pin from the mould will equal half of the short diameter.

Niche mouldings and panel mouldings are run by screeds or trammels, as the occasion may require.

Cast centers, rosettes, brackets, and other such ornaments are made in moulds which are put together in sections, with an orifice in which to pour the plaster, which is made thin enough with water to pour readily, no lime being used. Basso relievos, etc., are run in open moulds, made all in one piece. These moulds should always be oiled before using. Most of these moulds are made of plaster, hardened with glue or shellac, but moulds for basso relievos are often made of beeswax. Plaster ornaments are fastened up in their places with fresh gauged plaster, and sometimes a few screws to help hold up the heavier ones. When screws are used they should be countersunk, and the heads should be covered with plaster so that they will not be seen.

CHAPTER VII.

MISCELLANEOUS.

Lathing.—In common lathing the spaces between the laths should be one-quarter of an inch. If they be made less than that, the clinches will not be strong enough, and if more, they will sag down on the ceiling, and drop off with their own weight on the sides; and in no case should the spaces exceed two-fifths of an inch, except when the furring is very thin, like strips of lath nailed on inside sheeting or ceiling. Most lathers break joints every sixth lath, and some every tenth; but it is still better to break joints every second lath. When ordinary laths are used, of from one-quarter to two-fifths of an inch in thickness, the studding, joists, etc., should never be over sixteen inches apart—twelve inches would be better. Lathing is estimated by the square yard, and is measured the same as plastering, without deducting openings for doors, widows, etc., except when the opening exceeds sixty-three square feet.

Chimneys.—The object of a chimney flue is a safe and efficient means of carrying off smoke, hot air, etc; therefore, security is the main point inside of the building. In order to attain that end, the flue must be plastered smoothly inside, and must be

as straight as practicable, thereby securing a good draft, thus preventing soot from collecting and frequently burning out. And the flue should also be built strongly, filling the joints carefully with good mortar to guard against cracking. Outside symmetrical form and clean work is an essential feature. Five courses of brick will lay up one foot in height, mortar joints included.

Whitewashing.—In order to do good whitewashing it is necessary to have a good brush, and good wash. These two being supplied, and a suitable scaffold being ready, dip the brush into the wash about half the length of the bristles, and then brush as much of the wall or ceiling as that amount of wash will cover, wetting it thoroughly; then finish by passing the brush once over the strip just put on, and immediately dip and repeat the process upon an adjoining portion of the wall or ceiling.

Avoid dry joinings, and be careful not to spatter. One coat is not generally sufficient to whiten an old wall.

Whitewashes.—1st, wash for fences—one-half bushel lime, slacked to putty; two pounds zinc white, dissolved in water; one pound common salt dissolved in water. If color is wanted, color to suit, and set the color with one table-spoonful of powdered alum.

2d. Wash for wood, brick, stone, or plastering—slack about one peck of lime in hot water, keeping

it covered during the slacking process; strain and add one-half peck of salt dissolved in water, one and a half pounds ground rice, put in boiling water and boiled to a thin paste, one-quarter pound powdered whiting, and one-half pound clear glue dissolved in warm water. Mix well together; let stand for several days, and apply hot. Color to suit. Coloring should be put in before the glue and paste.

3d. Another—fifteen pounds of whiting, one-half pound fresh slacked lime dissolved in skim-milk. Color to suit. This wash becomes as hard as paint.

Kalsomine.—To fifteen pounds best whiting or French kalsomine, disolved in cold water, add one pound fine white glue dissolved in water. *Apply cold.* For very fine white work zinc white is preferred to whiting, but as the expense is so much greater it is seldom used. One-half ounce of ultramarine blue added to the above gives a clearer white. Color to suit, but be sure to put in all coloring before putting in the glue.

Cheap Paint. — Hydraulic cement and skim-milk. Color to suit. Is not white.

Another—eleven pounds dry slacked lime sifted fine, one gallon water, one gallon linseed oil (raw or boiled), one-half pound potash dissolved in water by heating over the fire. First mix the lime and water, then add the oil and potash water. If the oil does not unite with the water, add a little more potash water, but only enough to cut the oil. Color to suit.

Granite Finish.—Brown ground-work—spatter first with white, then half as much with black, and then as much with red as with white. Used on outside work, and requires to be penciled to represent blocks of stone.

Stucco plastering—three or four bushels of quicklime to one bushel of hydraulic cement, with sand, six or seven to one.

Blackboards.—If on laths, plaster with three coats, as follows: Scratch-coat of good hair mortar, gauged with stucco (plaster of paris). When dry, brown with a coat of mortar described as "stucco-plastering," but using a larger proportion of cement. When that is dry, finish with a good coat of hard-finish, colored black with drop black, or lampblack dissolved in alcohol; and when the finish is dry apply two coats of liquid slating, made as follows: one pound white shellac, one-half pound powdered pumice-stone, one-quarter pound lampblack cut in one gallon pure alcohol. If the blackboard is to be put on a stone or brick wall, the scratch-coat may be omitted. Warranted to give satisfaction.

Tucking.—The tools used for tucking are a long and short straight-edge, with spirit-level and plumb inserted; the tucker's hawk eight inches square, with the handle at one corner, and a brad in the opposite corner, with which to hold the straight-edge and the tucking tool. The mortar is generally

made with quick-lime and white sand, or marble dust and a little cement, with proportions varying according to circumstances.

Hydraulic Mortar.—One part blue Lias lime to two and a half parts burnt clay, ground together.

Beton.—One part hydraulic mortar to one and a half parts of angular stones.

Concrete.—One part lime, two parts sand and four parts gravel.

Grout or Gravel Houses.—To eight barrows of slacked lime add fifteen barrows of sand. Mix to a creamy consistency, and then add sixty barrows of coarse gravel, and mix well together. Throw in as many stones as desired, not to exceed ten inches in diameter.

Gravel Walks.—Fifteen bushels of gravel, from three to five bushels of sand, and from one to one and a half bushels of lime. Coarse gravel requires more sand.

Waterproof Mastic Cement.—One part red lead, four parts ground lime, five parts sharp sand mixed with boiled oil; or one part red lead, five parts whiting, ten parts sharp sand mixed with boiled oil.

Marble Finish. — Hard-finish with dissolved lampblack, spattered on it in streaks with a pencil-

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brush just before troweling. The troweling will blend the streaks of black, making them resemble the seams or grain of marble.

Measurement of Plastering. — Plastering is generally measured by the square yard; and according to custom no deduction is generally made for doors, windows or other openings which do not exceed sixty-three square feet. In most places it is customary in measuring closets to add half of the contents to the contents, and if the shelves and strips are in before plastering, it is customary to double the contents. Small gables and other triangular pieces are generally counted square. These extra allowances are made to make up for the extra labor of plastering such pieces of work.

Comparison of Measures.—One bushel equals 2150.42 cubic inches; one gallon, 231 cubic inches; six and five-tenths barrels, one cubic yard; one load of earth, 21.7 bushels.

Table of Weights of Materials.—The following shows the weight (avoirdupois) per cubic foot of various kinds of material: Average mortar, 106 pounds; water, 62½ pounds; loose earth, 95 pounds; common soil (compact), 124 pounds; clay (compact), about 135 pounds; clay with stones, 160 pounds; brick, 125 pounds; lime, 64 pounds; sand (loose), 96 pounds.

And the following shows the bulk of one ton of

different substances in cubic feet: Sand, 28 cubic feet; earth (compact), 18 cubic feet; earth (loose), 32 cubic feet.

Bill of Material for One Hundred Yards of Plastering—Three Coats.—Eight bushels lime, one bushel hair, one load sand, one-quarter barrel plaster. This of course varies some with the qualities of material. About two bushels of lime are required for the finishing, the other six for the coarse mortar.

Miscellaneous Table.—The average weight of one bushel of mortar is $131\frac{1532}{1728}$ pounds. The average weight of one bushel of sand is 120 pounds. The standard weight of one bushel of lime is 80 pounds. The standard weight of one bushel of hair is 8 pounds.

How to Find the Area of a Circle.—Multiply the square of the diameter by the decimal .7854, or multiply the circumference by the radius, and divide the product by 2.

How to Find the Area of an Ellipse.—Multiply the long diameter by the short diameter, and by the decimal .7854. The product will be the area. Or multiply one-half of the long diameter by one-half of the short diameter, and that product by 3.1416.

FORM OF PLASTERER'S CONTRACT.

Contract for Plastering, made this....day of, one thousand eight hundred and...., by and between.....of....., in the County of....., and State of....., and.....of.....in the County of...., and State of...., Plasterer :

Witness, that the said.....covenants and agrees to and with said.....to plaster, in a good, substantial and workmanlike manner, the following described building: (Here describe the building.)..... Said plastering to be done with....coats, and finished in the following manner:..... ; and completed on or before the....day of....next. In consideration whereof said.....covenants and agrees to pay said.....the sum of....dollars, as follows:.....And for the performance of all the agreements above mentioned, the said....and.... do hereby bind themselves, their heirs, executors and administrators, each to the other, in the penal sum of....dollars, firmly by these presents.

In witness whereof, we, the said....and....have hereto set our hands the day and year first above written.

(Signatures.) (Seals.)

Executed and delivered in presence of } {
..... {

The above form may be varied to suit every case.

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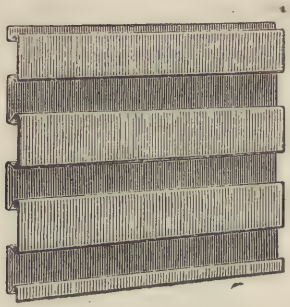
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